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2015 Ford E-350 Service and Repair Workshop Manual

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The turbocharger wastegate motor is an electric stepper motor. The PCM (powertrain control module) controls the turbocharger wastegate motor to change the position of the actuator linkage open or closed based on various engine airflow conditions depending on vehicle configuration and requirements such as fuel economy and boost performance. The turbocharger wastegate motor also contains an integral position sensor for turbocharger wastegate position feedback to the PCM (powertrain control module) .

The 6 cylinder electric turbocharger wastegate motors may be controlled independently with separate PCM (powertrain control module) control circuits for each bank.

Charge Air Cooler (CAC) System — Air To Air Cooled

The CAC (charge air cooler) system cools the intake air which has been heated by the turbocharger. The removal of heat from the pressurized air going into the CAC (charge air cooler) increases the air density which improves combustion efficiency, engine horsepower, and torque. The system consists of a CAC (charge air cooler) radiator in the grille and tubing to interconnect these components. The CAC (charge air cooler) is positioned after the turbocharger directly in the flow of the intake air. As the heated air flows through the CAC (charge air cooler) , it is cooled by the airflow through the grille. The PCM (powertrain control module) maintains a desirable intake air temperature by monitoring the turbocharger boost pressure/charge air cooler temperature (TCBP/CACT) and the MAP (manifold absolute pressure) / IAT2 (intake air temperature 2) sensors.

Component Description

Turbocharger

The turbocharger assembly is an exhaust driven centrifugal compressor. Expanding exhaust gases drive the turbine shaft assembly to speeds over 100,000 RPM (revolutions per minute) . The turbocharger increases the power output of an engine by increasing the mass of air entering the engine. The turbocharger has an integrated wastegate, an electric wastegate motor and a remote bypass valve.

Turbocharger Bypass Valve

The turbocharger bypass valve prevents back flow through the turbocharger when the throttle is rapidly closed to avoid undesirable noise. The high pressure downstream of the turbocharger is vented back to the intake air upstream when the turbocharger bypass valve is open reducing pressure in the system. The turbocharger bypass valve is solenoid controlled and located between the turbocharger intake and the turbocharger boost pressure output to the CAC (charge air cooler) .

Turbocharger Wastegate Motor

The turbocharger wastegate motor is attached to the turbocharger and allows the PCM (powertrain control module) to control the turbocharger wastegate position. The turbocharger wastegate motor controls the turbocharger wastegate linkage position to control the boost pressure limit. During driving conditions, the PCM (powertrain control module) controls the turbocharger wastegate motor position with positive and negative voltage circuits, to change the position of the turbocharger wastegate to increase or decrease the boost pressure to the desired value. The PCM (powertrain control module) monitors the turbocharger



Turbocharger Controls

303-04H Fuel Charging and Controls - Turbocharger - 3.5L V6 PowerBoost (CN)	2022 F-150
Diagnosis and Testing	Procedure revision date: 07/23/2021

Turbocharger Controls

Diagnostic Trouble Code (DTC) Chart

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.

REFER to: [Diagnostic Methods](#)

(100-00 General Information, Description and Operation).

Diagnostic Trouble Code Chart

Module	DTC (diagnostic trouble code)	Description	Action
PCM (powertrain control module)	P0034:00	Turbocharger/Supercharger Bypass Valve A Control Circuit Low: No Sub Type Information	GO to Pinpoint Test HN
PCM (powertrain control module)	P0035:00	Turbocharger/Supercharger Bypass Valve A Control Circuit High: No Sub Type Information	GO to Pinpoint Test HN
PCM (powertrain control module)	P0234:00	Turbocharger/Supercharger A Overboost Condition: No Sub Type Information	GO to Pinpoint Test HN

PCM (powertrain control module)	P2ABB:00	Wastegate Position Sensor B Circuit Low: No Sub Type Information	GO to Pinpoint Test HN
PCM (powertrain control module)	P2ABC:00	Wastegate Position Sensor B Circuit High: No Sub Type Information	GO to Pinpoint Test HN
PCM (powertrain control module)	P2ABD:00	Turbocharger/Supercharger Wastegate Actuator A Driver Current/Temperature Too High: No Sub Type Information	GO to Pinpoint Test HN
PCM (powertrain control module)	P2ABE:00	Turbocharger/Supercharger Wastegate Actuator B Driver Current/Temperature Too High: No Sub Type Information	GO to Pinpoint Test HN

Global Customer Symptom Code (GCSC) Chart

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.

REFER to: [Diagnostic Methods](#)

(100-00 General Information, Description and Operation).

Global Customer Symptom Code Chart

Customer Symptom	Action
Driving Performance > Lack/Loss of Power > Acceleration > Always	GO to Pinpoint Test HN
Driving Performance > Lack/Loss of Power > Cruise/ Steady Speed > Always	GO to Pinpoint Test HN

Pinpoint Tests

PINPOINT TEST HN : TURBOCHARGER SYSTEM

NOTE

To recreate the original conditions that set the DTC (diagnostic trouble code) or caused the symptom, the vehicle may require driving.

NOTE

control module) P0247:00	Type Information	reversed. Verify the TCWGM2+ and TCWGM2- circuit positions are correct in the harness connector.
PCM (powertrain control module) P0299:00	Turbocharger/Supercharger 'A' Underboost Condition: No Sub Type Information	Sets when the PCM (powertrain control module) detects the actual turbocharger boost pressure (TCBP) value is less than the desired turbocharger boost pressure (TCBP) value by 27.6 kPa (4 psi) or more for 5 seconds, indicating an under boost condition. Check tubing for restrictions, cracks and incorrect fitting connections. Check the turbocharger wastegate regulating valve solenoid for correct operation.
PCM (powertrain control module) P25B3:00	Turbocharger/Supercharger Wastegate 'A' Stuck Open: No Sub Type Information	Sets when the PCM (powertrain control module) detects the turbocharger wastegate 1 is at a greater angle than commanded. Check the turbocharger wastegate motor linkage for stuck or binding concern.
PCM (powertrain control module) P25B4:00	Turbocharger/Supercharger Wastegate 'A' Stuck Closed: No Sub Type Information	Sets when the PCM (powertrain control module) detects the turbocharger wastegate 1 is at a lower angle than commanded. Check the turbocharger wastegate motor linkage for stuck or binding concern.
PCM (powertrain control module) P25B5:00	Turbocharger/Supercharger Wastegate 'B' Stuck Open: No Sub Type Information	Sets when the PCM (powertrain control module) detects the turbocharger wastegate 2 is at a greater angle than commanded. Check the turbocharger wastegate motor linkage for stuck or binding concern.
PCM (powertrain control module) P25B6:00	Turbocharger/Supercharger Wastegate 'B' Stuck Closed: No Sub Type Information	This DTC (diagnostic trouble code) sets when Sets when the PCM (powertrain control module) detects the turbocharger wastegate 2 is at a lower angle than commanded. Check the turbocharger wastegate motor linkage for stuck or binding concern.
PCM (powertrain control module)	Wastegate Position Sensor 'A' Circuit: No Sub Type Information	Sets when the PCM (powertrain control module) detects the TCWP1 circuit voltage is greater than or

PCM (powertrain control module) P2ABE:00	Turbocharger/Supercharger Wastegate Actuator 'B' Driver Current/Temperature Too High: No Sub Type Information	Sets when the PCM (powertrain control module) detects the turbocharger wastegate motor 2 driver current is greater than a calibrated threshold.
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Possible Sources

- Intake air system concern
- Turbocharger bypass valve circuitry concern
- Turbocharger bypass valve (9K378)
- Turbocharger wastegate motor (9G488)
- PCM (powertrain control module) (12A650)

Pinpoint Test Steps available in the on-line Workshop Manual.

- Start the engine.
- Monitor the exhaust system.

Is blue smoke noticeable from the exhaust system?

Yes	GO to A2
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No	INSPECT for external oil leaks. REFER to the Oil Leak Inspection procedure in the 303-00 section for the engine being diagnosed.
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A2 CHECK THE AIR CLEANER

- Inspect the air cleaner.

Is the air cleaner clogged?

Yes	REPLACE the air cleaner. Refer to the 303-12 section for the engine being diagnosed. Check the system for normal operation.
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No	GO to A3
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A3 CHECK THE AIR INTAKE PIPES AND HOSES

- Inspect the air intake pipes and hoses for loose connections or leaks.

Were any loose connections or leaks found from the air intake pipes or hoses?

Yes	REPAIR or REPLACE the intake air system. Refer to the 303-12 section for the procedure.
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No	GO to A4
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A4 CHECK THE CRANKCASE VENTILATION SYSTEM

- Check the crankcase ventilation system for damage and correct operation. REFER to the 303-08 Diagnosis and Testing Crankcase Ventilation procedure for the engine being diagnosed.

Is the crankcase ventilation system damaged?

Yes	INSTALL a new turbocharger. REFER to the Turbocharger Removal and Installation procedure in this section.
No	Diagnose internal engine damage. REFER to the 303-00 Diagnosis and Testing procedure for the engine being diagnosed. Follow the pinpoint test to diagnose blue smoke.

PINPOINT TEST B : EXCESSIVE NOISE

Possible Sources

- Air intake system
- Engine
- Turbocharger

B1 COMPARE CUSTOMER CONCERN TO A KNOWN GOOD VEHICLE

- Compare the customer concern to a known good vehicle. Variations in vehicle options such as engine size, transmission or tire size will sound different. Compare to a vehicle similarly equipped. Compare the vehicle under similar driving conditions, like road test route, APP (accelerator pedal position) and load.

Is the noise excessively different from the comparison vehicle?

Yes	GO to B2
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No	The sound is a normal characteristic of the vehicle.
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B2 LOCATE THE SOURCE OF THE NOISE

- Using the Chassis/Ear, Engine/Ear, and VCMM accelerometers along with the scan tool, locate the source of the noise. REFER to the Engine Noise Identification and Location procedure in the 303-00 section.

Is the noise located near the turbocharger?

Yes	GO to B3
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No

GO to [C2](#)

C2 CHECK THE AIR CLEANER

- Inspect the air cleaner.

Is the air cleaner clogged?

Yes

REPLACE the air cleaner. Refer to the section 303-12 for the procedure. Check the system for normal operation.

No

GO to [C3](#)

C3 CHECK THE AIR INTAKE SYSTEM

- Check the air intake system, air cleaner and CAC (charge air cooler) components, ducts, pipes and hoses. Check that all components are installed correctly and tight. Check that all components are aligned correctly. Check for damage that could cause an air-intake leak resulting in a noise from the turbocharger(s). For additional information, refer to the 303-12 Intake Air Distribution and Filtering section for the engine being diagnosed.

Does the air intake system have any leaks?

Yes

Repair as necessary. Refer to the 303-12 Intake Air Distribution and Filtering section for the engine being diagnosed.

No

GO to [C4](#)

C4 CHECK THE EXHAUST SYSTEM

- Check the exhaust system for restrictions or damage. Refer to the 309-00 Exhaust System section for the engine being diagnosed.

Is the exhaust system restricted or damaged?

Yes

REPAIR as necessary. Refer to the 309-00 Exhaust System section for the engine being diagnosed.

- Gaskets
- Turbocharger

NOTE

It is very unlikely for the turbocharger to leak engine oil externally. The moving parts of a turbocharger that require oil are contained in a housing with no external sealing surfaces. Pressurized engine oil is supplied to the turbocharger from the engine through an oil supply tube and drains back to the engine sump through an unpressurized return tube. The most likely source of an external oil leak would be from the oil supply or oil return tubes or the gaskets and seals.

D1 CHECK THE OIL SUPPLY TUBE

- Perform an oil leak inspection. REFER to the Oil Leak Inspection procedure in the 303-00 section for the engine being diagnosed. Visually inspect the oil supply tube for traces of oil. Check the engine and the turbocharger ends. Check for oil running down from other areas of the tube or the engine to locate the source of the leak. Check the oil supply tube gaskets and seals.
- Movement of the vehicle, under hood components or gravity can cause oil leaks to appear in different areas from the source of the oil leak. Follow the trace of the oil leak to the source.



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Is the oil supply tube leaking oil?

Yes

INSTALL a new turbocharger oil supply tube. REFER to the Turbocharger Oil Supply Tube Removal and Installation procedure in this section.